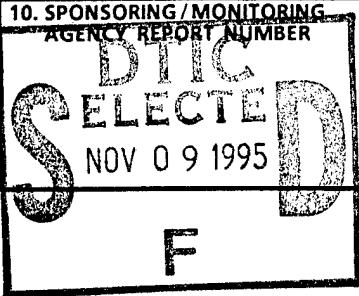


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THE OPERATIONAL THEATER MINE COUNTERMEASURES PLAN: MORE THAN A NAVY PROBLEM

A Monograph
By
Captain Bruce F. Russell
United States Navy



School of Advanced Military Studies
United States Army Command and General Staff College
Fort Leavenwoth, Kansas

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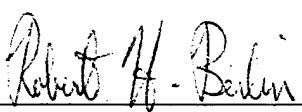
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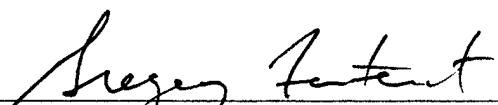
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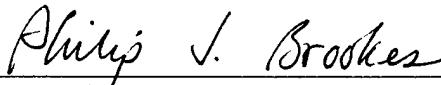
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ABSTRACT

THE OPERATIONAL THEATER MINE COUNTERMEASURES
PLAN: MORE THAN A NAVY PROBLEM by CAPT Bruce F. Russell,
USN, 48 pages.

This monograph finds that theater commanders, with vital maritime choke points/canals in their theater, should have their J-5 planners develop and integrate a comprehensive counter mine plan into the theater's campaign plans. In the past, regional mine countermeasure's plans have been viewed as a Navy responsibility. However, today's theater commander may face short regional conflict warning times which require the conduct of mine countermeasures (MCM) operations before Naval MCM planners and their forces (ships and aircraft) can arrive in theater. Using joint theater forces (Army, Air Force, Special Operations Forces, Navy, and Space assets), the theater commander can conduct MCM operations to prevent mines from going in the water or to detect and record locations of enemy mine laying operations, reducing greatly the time required for counter mine operations by Naval MCM ships and aircraft upon their in-theater arrival. The coordination and allocation of Joint theater forces to conduct MCM operations requires a theater commander to plan and prepare for mining threats long before the first enemy sea mine enters the water.

This monograph uses the Secretary of Defense's October 1993 Report on the Bottom-Up Review as a reference, to identify real world MCM missions from a scenario that involves two nearly simultaneous conflicts in the Korean and Persian Gulf regions. To execute counter mine missions in these theaters, the J-5 planning staffs must develop MCM plans for the theater commander. This monograph takes the J-5 planner through the required building blocks to develop an effective theater MCM plan.

The monograph describes the North Korean and Iraqi mining threat^s, past and present, to include mine types, mine delivery platforms, and possible battlespace areas that could be effectively mined. The strengths and weaknesses of U.S. MCM forces, ships and aircraft, are discussed and required theater MCM force levels determined. The relationship between MCM force deployment time and theater conflict warning time is presented to illustrate why the theater commander should rely on Joint forces vice Navy forces for theater MCM operations. Finally, the elements of a theater MCM plan are discussed to show the J-5 planner how Joint forces can prevent the enemy from laying mines, surveil the enemy during mine laying operations, and counter mines once they are in the water.

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I. INTRODUCTION

Mines, together with their counterpoint, mine countermeasures, make up a body of naval warfare called mine warfare...few forms of naval warfare have been so little understood and so underutilized by military professionals and statesmen alike. It is most appropriate and worthwhile that mine warfare be studied, understood, appreciated, and utilized in all its defensive and offensive subtleties--much as the knight, once studied, can be so valuable in chess.¹

Rear Admiral Charles F. Horne III, USN (Ret), 1991

Without prior warning, Iraq declares war against Kuwait and moves its forces south towards Kuwaiti and Saudi Arabian borders. The U.S. Persian Gulf theater commander, CINCCENT, is informed that currently there are no carrier battle groups or amphibious ready groups in the Persian Gulf. The theater commander immediately requests the Secretary of Defense to send two carrier battle groups and an amphibious ready group to the Persian Gulf. Additionally, he requests the Army's maritime prepositioning ships be sent to the Gulf to provide required brigade sets of equipment for Army personnel being airlifted to the theater. Responding to the CINC's requests, the Secretary of Defense orders one carrier battle group from the Mediterranean Sea and one carrier battle group/amphibious ready group from Japan to move to the Persian Gulf area of conflict. Orders are also given to the maritime prepositioning ships, located in Diego Garcia, to get underway and steam to assigned ports in the Persian Gulf.

As these ships are heading to the Persian Gulf, Iraq makes the startling

announcement that they have laid mines in the Red Sea and in the Persian Gulf to include the Strait of Hormuz. Iraq further warns that ships entering these areas do so at their own risk. Within hours of the announcement, a merchant ship is badly damaged by a mine in the Strait of Hormuz.

U.S. mine countermeasures (MCM) forces are ordered to transit to the mined waters. However, they will take anywhere from 10 to 20 days to arrive on station from base locations in Japan and the United States. An additional 10 to 15 days of MCM operations will be required to clear both the Red Sea and Persian Gulf shipping channels. Meanwhile, the Mediterranean carrier battle group is stuck at the mouth of the Suez Canal until a Red Sea shipping lane can be cleared of mines. Army maritime prepositioning ships along with the carrier battle group/amphibious ready group (ARG) from Japan arrive at the entrance to the Persian Gulf but cannot enter the Gulf until the Strait of Hormuz mine threat is neutralized. The mined waters of the Gulf are delaying vital strategic carrier air strike and naval blockade missions. U.S. Marine Corps helicopter missions to evacuate personnel from Kuwait are not being performed because the ARG cannot enter the Gulf. Finally, the theater commander, after assessing the situation, orders the carrier battle group and amphibious ready group stationed just outside the mouth of the Gulf to enter the mined waters of the Strait of Hormuz without MCM forces. The maritime operational situation from this point on only declines.

Although this scenario is fiction, the idea of attacking U.S. military and

logistical shipping through the use of sea mines is not. The sea mine is increasingly becoming the weapon of choice for countries with small navies to combat world class navies for control of the sea. The primary mission of sea mining operations is to deny or delay the enemy access to defined bodies of water such as sea lanes of communication, seaports, or military maritime operating areas. A secondary mission of sea mines is to divert the enemy from desired transit routes to time consuming, hazardous, and predictable transit routes.

To combat the strategic and tactical use of sea mines, the theater commander and his or her J-5 campaign planners need to develop a theater mine countermeasures plan which incorporates the following counter mine options:²

- 1. Prevent the enemy from laying sea mines in the first place.**
- 2. Avoid sea mines using available surveillance/reconnaissance methods**
- 3. Clear sea mines with MCM ships and/or aircraft**
- 4. Navigate vessels through a mine field, despite varying degrees of risk.**

The first two methods of countering enemy sea mines are the most preferred, take the least amount of time to accomplish, and do not rely upon the use of time consuming U.S. MCM ships or aircraft. The first method presumes that the theater commander can attack enemy mine laying vessels and enemy mine stockpiles before their employment, while the second method presumes that the theater commander, through surveillance and reconnaissance sources, knows the location of enemy mine fields. Lessons learned from mine countermeasures operations in the 1950 Korean War and 1991 Persian Gulf War show that theater

commanders, due to political and strategic reasons, may not be able to destroy enemy minelayers and mine stockpiles before their use and may not be able to always avoid enemy mine fields due to their location in restricted waters.

Knowing that counter mine options one and two cannot always be accomplished, the J-5 planners should plan for and be prepared to execute mine reconnaissance and clearance operations with U.S. mine countermeasures ships and aircraft. U.S. MCM forces do not routinely deploy with naval task forces and must transit from the United States or Japan to reach theaters of conflict. The number of days required for U.S. MCM forces to transit from their base locations to a conflict theater determines the day mine countermeasures operations can commence and affects greatly the day that a naval task force can enter a sea mine-free battlespace to begin power projection operations (see Figure 1). If the theater campaign time line does not permit the time consuming use of MCM ships and

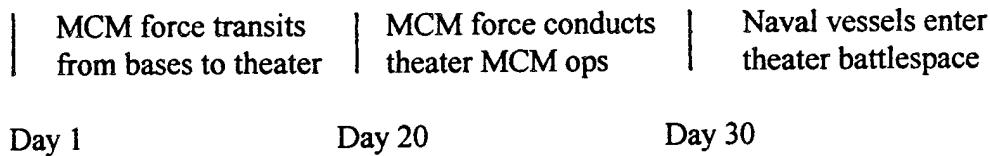


Figure 1. Notional Event Time Line for MCM Force Operations

aircraft or if MCM forces are not available, the last option is for the theater commander to order naval task force vessels to transit mined waters.

The objective of this monograph is to determine what counter mine courses of

action are required in a theater commander's MCM plan. The monograph also determines the transit time for U.S. MCM forces to reach two nearly simultaneous major regional conflicts, and analyzes how this transit time, when compared with conflict warning times, affects the theater commander's counter mine course of action selection process.

This monograph uses the Secretary of Defense's October 1993 REPORT ON THE BOTTOM-UP REVIEW as a reference, to identify real world MCM missions from a scenario that involves two nearly simultaneous theater conflicts.³ The Bottom-Up Review specifically addresses two regional dangers to the United States and its allies: the continued military preparations underway in North Korea and the ambitions of Iraq to dominate Southwest Asia. The Bottom-Up Review envisions the near simultaneous aggression of a remilitarized Iraq against Kuwait and Saudi Arabia, and by North Korea against the Republic of Korea.⁴

The review divides U.S. combat operations in the these two theaters into four phases:

1. Halt the invasion.
2. Build up U.S. combat power in the theaters while reducing the enemy's.
3. Decisively defeat the enemy.
4. Provide for post war stability.

In phase one of combat operations, the theater commander is tasked with establishing maritime superiority, using naval task forces with mine countermeasures assets, to ensure access to ports and sea lines of communication and as a precondition for amphibious assaults.⁵

To use MCM assets effectively in countering the enemy's ability to conduct mining operations, the theater commander and J-5 planning staff should develop a theater MCM plan. This plan should match U.S. mine countermeasure strengths (using all branches of the armed services) against the enemy's mining weaknesses. The planning process requires the J-5 staff to learn how the enemy's mining threat (past and present) affects U.S. maritime forces. The staff should then learn about the operational strengths and weaknesses of U.S. MCM forces to include the logistics process of transporting MCM assets to a theater of conflict. Finally, the staff should write a plan which uses four courses of action (preventing, avoiding, clearing, and transit through mine fields) to counter the sea mine threat. The first step in the MCM planning process, is for the J-5 planning staff to learn about the enemy's mining threat.

II. THE MINE THREAT

When you can't go where you want to, when you want to, you haven't got command of the sea. And command of the sea is a rock-bottom foundation of all our war plans. We've been plenty submarine-conscious and air-conscious. Now we're going to start getting mine-conscious--beginning last week.⁶

Admiral Forrest P. Sherman, 1950
CNO United States Navy

Control of the sea is usually a prerequisite for larger theater strategies involving land-based objectives. Command of the theater maritime battlespace allows the theater commander to project power ashore, conduct resupply operations to both land and naval forces and deny the enemy commercial and military use or the sea. An important part of military operations to gain control of the maritime battlespace is the destruction or neutralization of enemy mines. To plan for and conduct counter mine operations effectively, the J-5 planning staff should learn how the enemy, in this case Iraq and North Korea, has effectively used mines against the U.S. military forces in the past. The lessons learned from these U.S. counter mine operations, combined with knowledge of the enemy's present mining capabilities, provides the J-5 planner with a strong threat foundation upon which to build a flexible and effective theater mine countermeasures plan. To understand the enemy mining threat, the J-5 planner should first learn about basic mining principals.

Mines are laid in shallow water, rivers, harbors, seas, channels and oceans. They make blockades and barriers and can be delivered by aircraft, submarines,

surface combatants, merchant vessels, boats, and barges. Their targets are vessels floating on the water or submarines below the water's surface. Mines are small, easily concealed, cheap to acquire, require virtually no maintenance, have a long shelf life, and are easy to store in large numbers. The sea mine is used strategically and tactically to deny waters to hostile forces and to defend high value targets such as ports and anchorages from amphibious or seaborne attack.

A mine is designed to damage ships in two ways. The first is through direct contact between the steel hull of the ship and the mine, were the explosion results in a breach of the ships hull. Damage is caused by flooding and the transmission of shock waves throughout the ship. The second way is through an underwater mine explosion causing a concussion wave, coupled with a destructive gas bubble, to travel through the water into the ship's hull, resulting in the breaking of the ship's interior piping, the misalignment of bearings, and structural damage to the ship's keel, rudder and/or screws.⁷ Mines are most commonly categorized as moored contact, drifting contact, bottom influence, moored influence, or rising (see figure 2).⁸

The moored contact mine, simply defined, is a naturally or semi-buoyant body which is tethered to an anchor on the ocean floor. A contact mine is the least complex of all mines and the easiest to produce. Moored contact mines damaged the SS Bridgeton and the USS Samuel B Roberts during Operation Earnest Will and damaged the USS Tripoli during Operation Desert Storm.⁹ The moored contact mine is generally the least difficult (not to imply easy) of all mines to

detect. It is tethered above the ocean floor and is somewhat simpler to sight visually or with a sonar device. This mine is also the least difficult for MCM forces to neutralize or destroy.

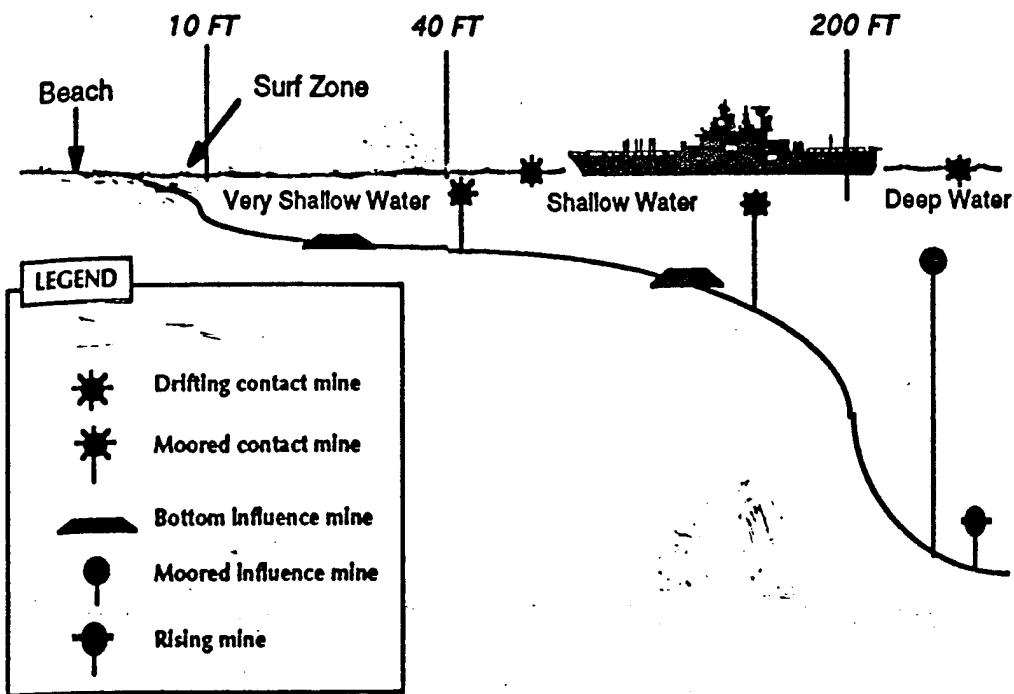


Figure 2. Types of Mines

The drifting contact mine is not tethered or moored on the sea/ocean floor. The mine floats on or just below the water's surface, drifts with the current, and detonates upon contact with a ship's hull. Indiscriminate in its choice of shipping targets, this mine is poor to use when attempting to neutralize or destroy a particular type of ship. It is an excellent terrorist type weapon to use for psychological impact on shipping operations.

The bottom influence mine is one of the most difficult of all mine types to

detect and destroy. Since this mine lays on the ocean bottom it can become buried in the mud, sand, and silt floor. Burial does not have a negative impact on the mine's magnetic, acoustic and pressure sensors and does not diminish the explosive force of the mine. To further exacerbate the difficulty of detecting a bottom mine, the sea/ocean floor is cluttered with numerous drums, containers and garbage which to a sonar device looks like this type of mine. Detecting and neutralizing bottom contact mines is a time consuming MCM operation. In waters deeper than 200 feet, the bottom influence mine becomes ineffective against shock-hardened ships as found in the U.S. Naval forces. A bottom influence mine was responsible for damaging the USS Princeton during the Persian Gulf War.¹⁰

The moored influence mine is used in water depths beyond 200 feet.¹¹ Like the moored contact mine it is tethered by wire and anchor to the ocean floor, but is detonated by a ship's magnetic, acoustic, and/or pressure signature vice physical contact. This mine, like the moored contact mine, is easier to find and neutralize by MCM forces.

The rising mine is used to water depths around 1000 feet.¹² It uses acoustic sensors to detect a target and release a warhead when the target is within range. Upon release, the warhead is either propelled to the target using a torpedo or rocket or it rises by buoyancy.

With the knowledge of moored and bottom mine categories, the J-5 planner should continue to build a mine threat picture by learning how the enemy,

specifically North Korea and Iraq, has used mines and mining operations effectively against U.S. military forces in the past. The past U.S. mine countermeasures operations in North Korea and Iraq provide the J-5 planner with valuable lessons learned that can be applied to future MCM planning efforts. Present North Korean and Iraqi mining capabilities are also discussed to provide the J-5 planner with today's mining threat that could be used against U.S. maritime forces in the not so distant future.

NORTH KOREAN MINE THREAT: PAST AND PRESENT

THE KOREAN WAR

In June 1950, North Korea invaded South Korea. Within weeks of the invasion, the USSR sent a team of mine laying experts, with mines, to North Korea. Experienced Soviet mine warfare officers personally helped mine the North Korean ports of Wonsan and Chinnampo with moored contact and magnetic mines and instructed the North Koreans in mine warfare operations. Additionally, the North Koreans mined the ports of Inchon, Haeju, Kunsan and Mokpo.¹³

UN forces first found mines in September 1950 off Chinnampo. When these mines were discovered, the Commander Naval Forces, Far East, Admiral C. Turner Joy, renewed his previous August 1950 attempt to obtain more minesweepers. His request was ignored until North Korean mines began to damage UN vessels, which included a minelayer off Haeju. The Chief of Naval

Operations, Admiral Forrest P. Sherman, then deployed several minesweepers which did not arrive until October 1950.¹⁴

In mid September 1950, the UN forces invaded Inchon. The invading UN forces were lucky that the North Korean mines protecting Inchon were unsophisticated and countered without difficulty. Destroyers in the assault visually spotted and fired on moored contact mines in the channel at low tide. The invading forces passed over the remaining mines at high tide and suffered no mine casualties.¹⁵

After taking Inchon, General Douglas MacArthur, Commander in Chief, Far East, planned a two-pronged invasion of North Korea. A main force would advance overland from Seoul to the capital of North Korea (P'yongyang), while one corps was assigned to make an amphibious landing on the beaches of Wonsan. Mine countermeasures operations in the Wonsan channels and harbor were allotted ten days to clear mines.¹⁶

The Navy began mine sweeping operations on 10 October and that day swept 21 contact mines with no casualties. On 11 October mine hunting pushed to the entrance of Wonsan harbor. On 12 October, minesweepers Pirate (AM-275) and Pledge (AM-277) were sunk in the harbor by mines along with loss of 200 sailors. Mine sweeping came to an abrupt halt.¹⁷

The North Korean's had placed an extensive mine field of 3000 mines spread over 400 square miles in the approach to and in the Wonsan harbor using sampans and junks as minelayers.¹⁸ In Wonsan harbor, Russian contact mines

were mixed with new magnetic bottom influence mines sensitive enough to react to the wooden minesweepers engines, making mine sweeping by surface vessels deadly.

The actual landing at Wonsan was delayed one week as 50,000 men in a powerful 250-ship armada were held at bay by sea mines.¹⁹ Commander Amphibious Task Force Rear, Admiral Allen E. "Hoke" Smith informed the Chief of Naval Operations, Admiral Sherman, of the mine disaster at Wonsan as follows:

We have lost control of the seas to a nation without a Navy, using pre-World War I weapons, laid by vessels that were utilized at the time of the birth of Christ.²⁰

Admiral Joy commenting on Admiral Smith's official report on the Wonsan operation concluded:²¹

The main lesson of the Wonsan operation is that no so-called subsidiary branch of the naval service, such as mine warfare, should ever be neglected or relegated to a minor role in the future. Wonsan also taught us that we can be denied freedom of movement to an enemy objective through the intelligent use of mines by an alert foe.

The Wonsan operation highlights two areas of concern for the theater commander and the J-5 planning staff. The first area of concern is mine threat intelligence. In Wonsan, the U.S. forces were surprised by the new Russian magnetic influence mine which targeted mine sweepers. This surprise delayed the amphibious invasion by one week and caused a militarily ineffective assault operation. Today, U.S. enemies are modifying old mines and developing new

mines to counter military maritime forces. U.S. intelligence agencies are constantly exploiting and reporting on these new mine threats. Extracting this enemy mine threat intelligence information from the intelligence system to understand how these new mine threats will counter the current theater MCM plan is a continuous J-2 (intelligence)/J-5 team responsibility.

The second area of concern is maritime battlespace surveillance and reconnaissance operations. These operations gather intelligence on enemy mining operations before MCM forces are committed. The importance of MCM surveillance and reconnaissance operations cannot be overstated. Suppose the Wonsan harbor entrance was reconnoitered with underwater swimmers before the commencement of MCM operations. The information gathered on the mine field's size, mine types, and number of mines could have been forwarded to the amphibious task force commander. With this information, the amphibious task force commander could have predicted a long and difficult mine countermeasures operation, informed the chain of command, and changed amphibious assault time lines to match the mining threat. To effectively identify enemy mine field locations and mine types, surveillance and reconnaissance assets need to be allocated to MCM operations in the theater MCM plan, with the mission of monitoring and recording potential enemy mine layer movements.

THE PRESENT NORTH KOREAN MINE THREAT

The North Korean military presently possesses moored contact and bottom

influence mines that can be delivered to Korean waters by surface, aircraft, and submarine platforms. These mines can be used in water depths from 18 to 600 feet. The bottom mines have the capability to delay their activation time for up to 10 days after water delivery.²²

During heightened tensions between North and South Korea, over water movement tracks of North Korean surface vessels and aircraft should be monitored by U.S. national assets to detect possible mine field locations. North Korean submarines, which can covertly deliver up to 30 mines per sortie to all waters surrounding Korea, will require special tracking considerations to monitor their movement.²³ Once the conflict begins, destruction of enemy mine laying platforms should be high on the theater commander's priority target list. North Korean mines, if allowed to be laid in Korean waters, are sophisticated, tough to counter threats that require time consuming operations by MCM ships and aircraft to neutralize. MCM lessons learned in the Gulf War are very similar to those learned or not learned in the Korean War. A look at Iraq's mining operation in the Gulf War will show that history can be repeated.

IRAQI MINE THREAT: PAST AND PRESENT

THE PERSIAN GULF WAR: OPERATION DESERT SHIELD/STORM

In August 1990 Saddam Hussein's army invaded and captured neighboring Kuwait. During the five months of Operation Desert Shield , the Iraqi military built an extensive mine threat (about 1157 mines) off the coast of Kuwait which

affected almost all naval operations during the Persian Gulf Conflict.²⁴ Most of Iraq's mine inventory consisted of Iraqi reproductions of pre-World War I designed Russian contact mines. However, the Iraqis also had high technology magnetic and acoustic mines purchased from the former Soviet Union and Italy. These mines were delivered to off shore mine fields by Iraqi surface and air platforms.²⁵

Iraq's mine laying strategy focused on protecting its seaward flank from an amphibious assault. The Iraqis laid fields of moored contact and bottom influence mines protect logistics sea lines of communication and the Kuwaiti coast from amphibious assault. Additionally, the Iraqis deliberately set some mines adrift in the Persian Gulf to disrupt naval operations. The drifting mine threat was a considerable concern to the aircraft carriers operating in the Persian Gulf.²⁶

During Desert Shield, U.S. Naval mine sweeping forces began to arrive in theater. The minesweepers USS Impervious (MSO 449), USS Adroit (MSO 509), USS Leader (MSO 490), and the USS Avenger (MCM-1) arrived in Bahrain on 30 September via the Dutch heavy-lift ship Super Servant III, after nearly 50 days from the date of onload in Norfolk, Virginia.²⁷ On 7 October, ten days after departing the United States, six MH-53E MCM helicopters arrived in the Persian Gulf via C-5A aircraft. The USS Tripoli (LPH-10), which had been part of the amphibious task force, was assigned as the support ship for the MCM helicopters. A USMC landing force disembarked USS Tripoli and off loaded its equipment on 22 January to make room for the squadron of MCM helicopters.²⁸

Before the start of Operation Desert Storm, the U.S. military's ability to gather intelligence on Iraqi mine field locations, or observe and counter Iraqi mine laying efforts in international waters was restricted. To avoid the possibility of provoking Iraqi military action before the start of Desert Storm, CINCENT restricted naval forces from operating north of the 27°30'N parallel until early January 1991.²⁹

After Operation Desert Storm began, the primary mission of MCM forces was to clear a path to the Kuwaiti coast for naval gunfire support and a possible amphibious landing. The original plan was to clear an approach channel and a staging /fire support area of more than 200 sq.n.mi. for an amphibious assault near Ash Shuaybah. CENTCOM planners estimated the clearance time for the operation would take 10-14 days. Theater decision makers judged this time frame to be too long and the amphibious landing was cancelled.³⁰ The MCM plan then called for the clearance of a smaller staging area (54 sq.n.mi.) for a raid on Faylaka Island. This operation was to take six days.³¹

As the MCM force was sweeping toward Faylaka Island on 17 February, it was targeted by Iraqi Silkworm anti ship missile control radars in Kuwait. The MCM force moved out of the Silkworm missile's range while Desert Storm forces located and attacked the radar sites. As the Silkworm threat diminished , the MCM forces moved toward their previous mine sweeping areas. At 0435 on 18 February, the USS Tripoli, after operating for 11 hours in an undetected Iraqi mine field, hit a moored contact mine in 30 meters of water. The mine detonation

blew a 16 foot by 20 foot hole in her starboard beam. Although damaged, the USS Tripoli, with eight MCM aircraft aboard, remained temporarily on station to support mine sweeping operations. A few hours later and ten miles away, the Aegis cruiser USS Princeton (CG-59) actuated a Manta bottom influence mine in 16 meters of water, followed shortly by a sympathetic actuation of another mine about 350 yards from her bow. The mine blasts lifted the USS Princeton out of the water and caused substantial damage to her superstructure, hull, and one propeller. Lead by the minesweeper USS Adroit, a salvage ship, the USS Beaufort (ATS-2), towed the USS Princeton to safe waters. The mine clearing effort was barely underway before it was dead in the water. The waters off Faylaka Island, believed to be mine-free, had put two U.S. naval warships out of action.³²

The final report to Congress entitled "Conduct of the Persian Gulf War" summarized the maritime campaign with respect to the Iraqi mine threat as follows:³³

The five months of Operation Desert Shield permitted the Iraqis to develop an extensive coastal defense system in Kuwait. The Iraqi mine threat affected almost all naval operations during the Persian Gulf Conflict. The Coalition's ability to conduct amphibious operations and Naval gunfire support was constrained by the mine fields in the northern Persian Gulf. The mine threat also affected naval strike operations because it forced the carrier battle groups in the Persian Gulf to operate at greater ranges from targets in Iraq. The presence of drifting mines in the southern Gulf or within a major port in the Gulf could have severely limited the rapid force build up in Operation Desert Shield. Similarly, the mines laid in Kuwaiti ports could have affected seriously the Coalitions ability to shift logistics support rapidly to those ports.

The prevention of enemy mines from entering the water and the surveillance

of Iraqi mine laying assets was not allowed by the commander of United States Central Command, General H. Norman Schwarzkopf, during Desert Shield. While this action alone did not cause the failure of amphibious assault operations, it did allow Iraq to freely lay mines off of Kuwait from August 1990 to February 1991.³⁴ As the Kuwait amphibious assault plan was briefed to CENTCOM, the CENTCOM staff was surprised by the long 10-14 day requirement to clear the mines off the Kuwait coast. For the staff to be surprised, in view of General Schwarzkopf's decision, showed a serious lack of understanding about mine warfare on the part of the CENTCOM staff. The Desert Storm mine countermeasures experience underscores the need for a comprehensive theater MCM plan to be developed far in advance of major theater conflicts. The MCM plan should define the required rules of engagement to prevent the enemy from laying mines and allocate national and military assets (not just naval assets) to surveillance and reconnaissance missions to monitor enemy mine laying operations. Additionally, the theater MCM plan development process serves as a vehicle to educate the theater commander and staff about the actions required for a successful counter mine operation.

THE PRESENT IRAQI THREAT

Iraq still has the capability to conduct mining operations. Before Desert Storm, Iraq was estimated to have a mine inventory of around 2000 mines.³⁵ Iraq reported, after the war, that it had laid 1,167 mines during the conflict, leaving a post 1991 inventory of approximately 800 mines.³⁶ In addition to these mines,

Iraq also produces a moored contact mine, the LUGM-145, and a bottom acoustic influence mine, the Sigeel/400. Other mines known to be in the Iraqi inventory include the Soviet M-08 moored contact mine, the Italian Manta acoustic/magnetic bottom mine, the Russian KMD magnetic influence bottom mine and the Russian UDM acoustic influence bottom mine.

Iraq can deliver these mines from surface and air platforms. Practically any Iraqi surface vessel, as demonstrated in Desert Storm, can become a minelayer.³⁷ Iraq has the capability to expand its mining operations areas to include the entire Persian Gulf, the Suez Canal, and the Gulf of Suez. Currently, Iraq does not possess a submarine mine laying capability.³⁸

III. U.S. NAVAL MINE COUNTERMEASURES FORCES

Mine warfare may not be considered glamorous, some even call it ugly, but it works and works well....Mine warfare encompasses the entire spectrum of warfare, and it can threaten our future national security, our economic health, and that of our friends and allies. It can't be ignored. Too often mine warfare, particularly mine countermeasures, are [sic] considered after the fact. One hundred, even forty years ago, we could afford to do that. Today we can't.³⁹

Admiral Trost, 1989
CNO United States Navy

The direct approach, when facing mined waters, is to attack the mine by simulating a ship's magnetic and acoustic influence, causing the mine to actuate. Another possibility is to find the mines somehow and nullify them by some means, including blowing the mines up with explosives. These two methods, performed by ships and aircraft, are called mine sweeping and mine hunting, and constitute the world of mine countermeasures (MCM). To develop the counter mine portion of the MCM plan, the J-5 planner should first understand how MCM forces conduct their mission and then learn about the operational strengths and weaknesses of MCM ships and aircraft.

Mine sweeping missions against a moored mine is performed by towing mechanical cutting gear behind a MCM ship or aircraft. The gear cuts the mooring cable of the moored contact mine which allows the mine to float to the surface and be destroyed. Mine sweeping against a bottom mine is conducted by detonating the mine through false magnetic and/or acoustic signatures from

equipment towed behind the MCM ship or aircraft. Mine hunting is accomplished by examining an underwater area through the use of a sonar device on the MCM ship or by towing a sonar behind the MCM aircraft. Once mines are discovered through mine hunting, they are marked on a navigational chart for avoidance or are destroyed if time permits.

U.S. MCM FORCE: STRENGTHS AND WEAKNESSES

Mine countermeasures, when performed by ships and aircraft, is tough, time consuming, dangerous work. MCM force operations are adversely affected by bad weather, night time, and high sea states. Each MCM platform (ship/aircraft) has certain strengths and weaknesses that make their counter mine operations unique.

The Avenger class ship is a relatively large mine countermeasures vessel intended to be deployed to coastal waters, choke points, and critical overseas areas. Equipped with sweep gear, variable depth sonar, and a mine neutralization system, this ship is durable and can operate on-station, day and night, for long hours. It performs mine hunting at a maximum speed of 5kts and mine sweeping at speeds of 6-8 knots. It has a the capability of finding/countering mines in deep water (200ft and below). The main weakness of the MCM-1 is its lack of speed to rapidly deploy over large distances (maximum transit speed is 10-12kts whereas a U.S. naval task force transits anywhere from 16 to 20 knots), which can be costly when time is a critical factor. If the transit distance is long, such as a deployment from Ingleside, Texas to the Persian Gulf, the MCM-1 will be transported by a

commercial heavy lift ship(ie. the Super Servant III, having a maximum transit speed of 12kts) to reduce MCM-1 engine running time and eliminate the need for a major MCM-1 engine overhaul upon arrival in the operating theater.⁴⁰

The MH-53E MCM helicopter is capable of performing mine sweeping and mine hunting missions. The MCM helicopter tows a wire cable with attached mechanical cutting devices (speed 7 knots) to cut moored mine cables which releases mines to the surface. The helicopter also tows an influence sled (speed 25kts) which simulates a ship's propeller and/or a ship's magnetic signature to detonate bottom mines. Additionally, the helicopter tows a side scanning sonar device (speed 18kts) to locate moored and bottom mines. The aircraft are rapidly deployable (ten days) to overseas theaters by Air Force C-5A and C-141 aircraft. The MCM helicopters are also used in shallow water to perform precursor sweeping for the MCM ships. Weaknesses of MCM aircraft include not having a dedicated surface platform to serve as a flight deck and support ship, and not being certified to conduct night mine sweeping/hunting operations.⁴¹

Each MCM platform (ship/aircraft) has inherent strengths and weaknesses which must be integrated and used in tandem to combat the theater mine threat. The aircraft can get to the fight faster, sweep/hunt mines at a faster speed, but cannot conduct MCM operations at night and must be based on a mother ship (LHA or LHD) that has conflicting U.S. Marine Corps and MCM force responsibilities. The ships take longer to arrive in theater, but can influence sweep and hunt mines 24 hours a day and operate in worse weather conditions

than aircraft. To create the optimum MCM fighting force, the theater commander should be provided a mixed force of MCM ships and aircraft. This mixed MCM force will give the campaign planner the flexibility and balance to attack all mine threats throughout the theater battlespace.

U.S. NAVAL MCM FORCE LEVELS

The U.S. MCM force consists of the following active duty and reserve ships and aircraft:⁴²

- * 14 Avenger class (MCM-1) ships (10 active duty and 4 naval reserve)
- * 12 Osprey class (MHC-51) ships (1 active duty and 11 naval reserve)
- * 4 MH-53E MCM aircraft squadrons, 6 aircraft per squadron (2 active duty and 2 naval reserve)

From the above force, the U.S. Navy has ten active duty MCM-1 ships and two active duty MH-53E MCM helicopter squadrons to immediately respond to theater conflicts.

THEATER U.S. MCM FORCE LEVEL REQUIREMENT

MCM force requirements for theater operations will vary depending upon the perceived mine threat. The following MCM force package provides the initial capabilities required for most theater mine countermeasures operations:

- 3 MCM-1 mine countermeasures ships
- 1 squadron of MH-53E helicopters (six aircraft)

This theater MCM force package will provide the foundation for determining

MCM force deployment times to the North Korean and Persian Gulf theaters.

IV. THE RELATIONSHIP BETWEEN MCM FORCE DEPLOYMENT TIME AND THEATER CONFLICT WARNING TIME

Logistic considerations are key to the theater commander's estimate process, will greatly impact on the development of course of actions, and may dictate course of action selection.⁴³

Joint Pub 3-0

MCM force deployment times to the Persian Gulf and Korean theaters will vary depending upon which of the two nearly simultaneous conflicts begins first. Time lines, depicting the number of days required to transport a desired mixed MCM force of three MCM ships and one MCM aircraft squadron to the Persian Gulf and Korean theaters, are shown in Appendix C. The Case I time line depicts Persian Gulf and Korea MCM force arrival days when the conflict with Iraq occurs first. The Case II time line depicts Persian Gulf and Korea MCM force arrival days when the North Korean conflict occurs first. The MCM force deployment times were calculated by combining the present base locations of U.S. MCM forces (see Appendix A) with the time required to transport MCM forces from base locations (see Appendix B) to the Korean and Persian Gulf theaters. Some MCM force logistics realities can be drawn from the time lines in Appendix C.

The time lines show that a MCM aircraft squadron takes ten days to reach either conflict theater. The ten day time frame assumes that C-5A/C-141 aircraft are available to the operational commander on demand and that the theater

campaign plan assigns airlift priority to the MCM aircraft squadron over other theater airlift requirements. The theater arrival day for MCM-1 ships is not as consistent. The MCM ship arrival day depends upon which conflict starts first, and the base location the MCM ship. For example, given present MCM ship base locations, the Persian Gulf theater commander will wait a minimum of 20 days for MCM ships to arrive if his conflict starts first and as long as 34 days if the Persian Gulf conflict starts second. The Korean theater commander has two MCM-1 ships arriving on day one if that conflict begins first, but must wait 50 days for the arrival of two MCM-1 ships if the Korean conflict starts second. Basing two MCM ships in the Persian Gulf, as recently proposed by CINCCENT, would reduce MCM ship transportation time.⁴⁴ This proposal, depicted in Appendix D, would dramatically reduce the transportation days required to get MCM ships to the first theater conflict. However, the second conflict theater commander must still wait 34 to 50 days for the arrival of MCM ships.

Comparing MCM force deployment time with varying theater conflict warning times illustrates the impact that MCM force deployment time has on theater counter mine operations (see figure 3). The longer the conflict warning time, the higher the probability that MCM forces will arrive in theater before the conflict starts. The shorter the conflict warning time, the lower the probability that MCM forces will arrive in theater before the conflict starts, and the more a theater commander must rely on courses of action that prevent mines from going in the water, or actions that surveil enemy mine laying operations.

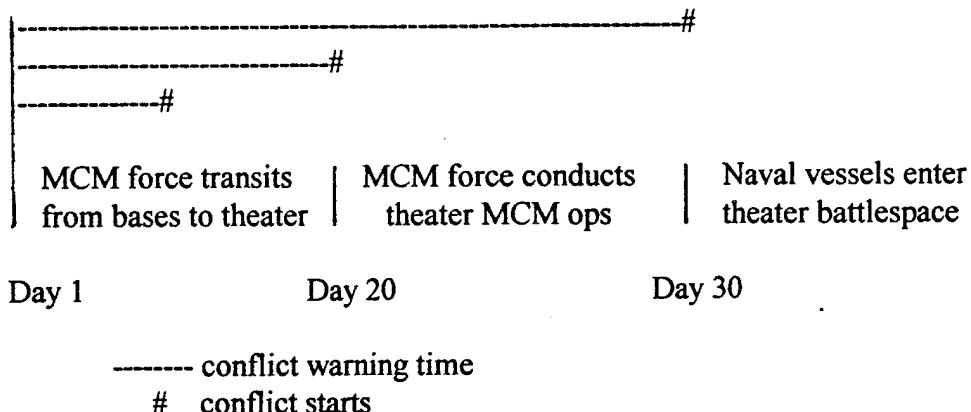


Figure 3. Conflict Warning Time vs. MCM Force Deployment Time

Knowing that MCM forces may require long deployment times and that Iraqi and North Korean conflicts may occur with short warning times, theater commanders and their J-5 planners should plan for and be prepared to accomplish mine countermeasure operations without the initial use of MCM forces. The theater MCM plan must be comprehensive enough to include counter mine courses of action that can be initiated before U.S. MCM forces arrive in theater.

V. MINE COUNTERMEASURES PLAN FOR THE OPERATIONAL THEATER COMMANDER

There is a premium on comprehensive intelligence and offensive mine countermeasures-the most effective of which is to prevent mines from going into the water in the first place....⁴⁵

ADM Frank B. Kelso III, 1992
CNO United States Navy

An effective counter mine plan will do more than just rely on MCM forces to perform mine clearing. The MCM plan should first address how to prevent enemy mining operations. Several actions can prevent an enemy from laying sea mines. First, a preemptive strike on enemy mine storage areas, ports and potential mine layers could prevent or curtail the enemy's ability to lay sea mines. In the case of Iraq, using joint surveillance and strike capabilities against their mine stockpiles and port loading/docking facilities could be a sound strategic and operational choice where it is allowed. However, this action may create unwanted problems for the theater commander; legal, political, or operational considerations may preclude a preemptive strike in some cases. A second, less aggressive approach, would be to set up a naval blockade at the enemy's territorial limits to seize or turn back ships carrying mines.

During Operation Earnest Will in 1987, for example, Navy SEALs were able to seize an Iranian landing craft loaded with moored contact mines. Preventing mine-carrying ships from leaving the territorial limits would at least limit the extent of the mine problem and provide a relatively clear staging area for an over the horizon amphibious assault. This action may also not be allowed. During

Operation Desert Shield, COMUSNAVCENT, Vice Admiral Stanley Arthur, determined that Iraq was laying sea mines in the waters off Kuwait. Vice Admiral Arthur subsequently requested authority to sink the Iraqi minelayers in the act and was denied permission to do so.⁴⁶ This decision was predicated on political negotiations, a desire not to prematurely start the war and on interpretations of international law. Had COMUSNAVCENT received permission to attack, Iraqi efforts to mine the waters off Kuwait may have been severely hampered and coalition MCM forces may have spent less time mine hunting and mine sweeping. Prevention of mine laying is a high-leverage option, but it is not a guaranteed solution. When prevention is not possible, then the next best option is to avoid the mines.

If the theater commander cannot prevent mines from being laid, the next best course of action is to conduct surveillance and intelligence-gathering efforts to determine where and what type of enemy mines are being planted. National assets could be assigned missions to gather data on enemy port activity, mine storage/staging areas, locations of potential enemy minelayers, and enemy shipping tracks.⁴⁷ Additionally, MCM aircraft, upon arrival in theater, can conduct mine reconnaissance missions in a relatively fast manner to locate mine fields. If the location of mine fields is known from surveillance, shipping routes or amphibious landing sites can be selected to possibly avoid mines altogether. There will always be some cases where avoidance of mines is not an option, such as, mines blocking the narrow Straits of Hormuz. In these cases the theater

commander must be prepared to clear mines or enter mined waters.

The execution of MCM clearance operations by MCM ships and aircraft is the most demanding and time consuming option in the theater commander's efforts to neutralize mines in the at sea battlespace. The theater commander should protect the MCM force during the mine sweeping and mine hunting evolutions from enemy attack, and at the same time, prevent the enemy from re-seeding mines in the at sea theater battlespace. This effort may require land based air support to interdict enemy targets ashore, such as, shore artillery and missile sites. The theater commander should be prepared to commit other forces (Special Operations forces, Army, Air Force, and Space assets) to accomplish the mine clearing effort.

At some point, the theater commander must be prepared to press on despite the risk from enemy mines. The degree of risk depends on how the mines are deployed (narrow mine lines or distributed over a large area; high or low density), how the battlespace is to be used (single transit through a channel or loiter in the area), how much damage ships can absorb, and how many ships can be lost in a particular operation. There are few situations in which the theater commander would simply ignore a mine threat, but if a critical maritime mission cannot wait for mine clearance operations, then ordering military ships into mined waters may be required. The key is to manage the risk, allowing the theater commander to make an informed decision about when it is prudent to transit into mined waters.

While the Navy is faced with the problems of developing faster and more

fleet-integrated methods of countering the sea mine threat, the theater operational commander should plan for and use all forces at his disposal, naval and non-naval, to deal with the very stubborn threat of mines. Given that sea mines are cheap, accessible, and historically have been highly effective against all types of shipping, operational theater commanders can expect to deal with this problem in the future. As the situation stands today, the theater commander and his J-5 planners should integrate comprehensive mine countermeasures courses of action into the theater campaign plan long before the first enemy sea mine enters battlespace waters. A theater mine countermeasures operation can no longer be solved by just throwing naval MCM ships and aircraft at the problem.

VI. CONCLUSION

Naval mines pose a serious threat in littoral environments. Potential adversaries can accomplish offensive and defensive mining not only by using inexpensive, primitive techniques, but also by acquiring new mine technologies that are resistant to current clearance measures. If preemption of an adversary's mine laying is not feasible, detection and avoidance, or location and neutralization of the mines by U.S. forces must be pursued. Failure to do so could hamper U.S. operational maneuvers from the sea and restrict the Navy's ability to control sea lines of communication.⁴⁸

Report of the Secretary of Defense to the President
and Congress, January 1994

The sea mine threat is not standing still. Mines continue to proliferate through regional navies and are becoming more sophisticated and deadly. Their widespread availability enables future adversaries to attack U.S. forces throughout the depth of the maritime battlespace. Sea mines may cause U.S. vessels to divert from desired sea routes and take longer alternative routes, increasing unit deployment times and lengthening theater resupply lines. Also, mines continue to have the potential to sink and damage logistics as well as combat vessels which may deny the theater commander needed supplies and maritime war fighting ships. During Desert Shield, for example, 85 percent of all supplies and equipment moved to the Persian Gulf theater arrived through the Strait of Hormuz by sealift.⁴⁹ If Saddam Hussein had mined the Strait of Hormuz, efforts to halt his invading force and build-up a strong coalition force in the Persian Gulf could have been drastically delayed, resulting in the loss of precious lives and territory. A flexible, robust, multi faceted mine countermeasures force is

required to combat and neutralize future enemy mining operations.

MINE COUNTERMEASURES: A JOINT OPERATION

Doctrinally, the countering of enemy mine threats has been the sole responsibility of the U.S. Navy. The Navy prepares the mine countermeasures plan for the theater commander and executes counter mine operations with naval assets. This concept is supported in Joint Publication 3-0 which calls mine warfare a "highly specialized... naval operation" and further states that "naval operations...involve clearing mines."⁵⁰ Nowhere in Joint Pub 3-0 is mine countermeasures referred to as a joint force operation.

However, today's MCM operations demand more than naval assets and naval planning to quickly and effectively destroy enemy mining capabilities. Theater commanders, faced with short regional conflict warning times and long U.S. Navy MCM force deployment times, will require the use of joint and national (space) assets to conduct successful future theater MCM operations. Joint Pub 3-0 should assign the MCM mission of surveilling enemy mining operations and the mission of destroying enemy mine inventory/delivery platforms to a joint team of Army, Air Force, Special Operations, and Navy forces. The Navy should retain the mission of mine clearance. To integrate these joint and national assets into counter mine operations, theater commanders (having vital maritime straits/canals and harbors supporting or located in their area of operations) and their J-5 staffs need to prepare and promulgate theater level MCM plans.

THEATER LEVEL MCM PLAN REQUIRED

The theater MCM plan should contain key joint MCM courses of action to be conducted before and during a major regional conflict. Counter mine operations required before the initiation of hostilities include intelligence gathering on enemy mining intentions and movements, naval blockades, transporting naval MCM forces to the theater, and targeting enemy mine stockpile locations and mine laying platforms for destruction.

Intelligence gathering plays an enormous role when dealing with an impending mine threat. Although surveillance assets will always be at a premium, some must be allocated to counter mine operations. The theater commander needs surveillance and reconnaissance assets to ascertain where the mine fields are located and what types of mines are being laid. The failure to monitor Iraqi mine laying activities during Desert Shield, was one of the greatest shortcomings of MCM operations in the Gulf War.

Setting up a naval blockade at the enemy's territorial limits to seize or turn back ships carrying mines will isolate the enemy by denying him access to vital maritime battlespace areas required for naval power projection and resupply operations. During Operation Earnest Will in 1987, for example, Navy SEALS were able to seize an Iranian landing craft loaded with moored contact mines. Preventing mine carrying ships from leaving the territorial limits would limit the extent of a mine problem and provide a relatively clear staging area for an amphibious assault over the horizon.

In addition to blockades, the destruction of enemy sea mine inventories and mine delivery platforms at the very beginning of the conflict should receive high prioritization during the pre hostility target selection process. As early as the international political scenario will allow, the theater commander must take every measure available to destroy the enemy's mine inventory and his capability to lay the mines. The prevention of sea mines from leaving enemy ports/airfields is perhaps the most effective counter mine tactic available and should receive a very high priority from theater commanders.

Once the hostilities have started, the theater commander will want to establish maritime superiority early in the conduct of joint operations. However, if enemy mines have been laid in battlespace waters, the theater commander, through the MCM plan, must understand that the clearing of these mines by naval assets will be slow and painstaking. MCM operations usually take weeks to clear battlespace areas depending on the density and type of mines, and upon the number of MCM ships and aircraft available for the operation. The theater MCM plan should serve as a decision matrix for the theater commander. The MCM plan needs to strongly illustrate that enemy sea mine threats must be addressed and handled at the pre hostility stage of a conflict. Ignoring the enemy mine threat or delaying MCM actions until the first mine to detonates, dramatically increases the risk of theater maritime operational failure.

"DAMN THE TORPEDOES, FULL SPEED AHEAD"

In one of the most well known phrases in naval history, Admiral David Glasgow Farragut ordered Union ships to continue their charge into Mobile Bay despite encountering mines (named torpedoes at the time), by saying "Damn the torpedoes, full speed ahead." However, what most people don't know, is that Admiral Farragut was well aware that the Confederate defenders had moored a number of mines to guard the channel of Mobile Bay. His men carefully reconnoitered the mine fields at night in small boats to learn where the mines were located and disabled some of the mines. Farragut's ships sailed into Mobile Bay only when they knew the extent of the mine field and had located a clear path through which to navigate.⁵¹ Admiral Farragut did not, as many believe, just "damn" the mines but rather, diligently hunted, examined, and disabled the mines before steaming into Mobile Bay. His thoughtful pre-planned approach to mine countermeasures and risk assessment is a critical lesson that should be learned by theater commanders and their staffs.

APPENDIX A

BASE LOCATIONS OF MCM FORCES

The current base locations of active duty MCM-1 ships are as follows:

Ingleside, Texas	8 MCM-1 ships
Sasebo, Japan	2 MCM-1 ships

The current base locations of active duty MH-53E AMCM squadrons are as follows:

Norfolk, Virginia	1 aircraft squadron
Alameda, California	1 aircraft squadron

SOURCE NOTE: "Tomorrow's Fleet: Part II", Truver, Scott,
US Naval Institute Proceedings, July 1994, p 87.
"Hello Asia, Goodbye Ingleside?", Blazer, Ernst,
Navy Times, March 8, 1995, p 8.
Interview with CO of HM-15, Apr 3, 1995.

APPENDIX B
DEPLOYMENT TIMES FOR MCM SHIPS AND AIRCRAFT

The following chart shows the number of days required to transport MCM-1 ships either by self lift or by a heavy sealift vessel at 12 knots from various possible base locations to the Persian Gulf and Korean conflict theaters.

<u>FROM</u>	<u>TO</u>	<u>TRANSIT DAYS</u>
Ingleside, Texas via Suez Canal	Persian Gulf	34
	Pusan, Korea	50
Ingleside, Texas via African Horn	Persian Gulf	43
	Pusan, Korea	54
Ingleside, Texas via Panama Canal	Persian Gulf	54
	Pusan, Korea	36
Hawaii	Persian Gulf	32
	Pusan, Korea	14
Sasebo, Japan	Persian Gulf	21
	Pusan, Korea	1
Persian Gulf	Pusan, Korea	20

A MH-53E squadron requires ten days and multiple C-5A/C-141 aircraft for transportation to the Persian Gulf or Korean theaters.

SOURCE NOTE: Mine Warfare Hearing, House of Representatives Committee on Armed Services, Seapower and Strategic and Critical Materials Subcommittee, Washington DC, Tuesday March 17, 1992, pp 111-112, 120-121.

APPENDIX C

NUMBER OF DAYS FOR MCM FORCES TO REACH PERSIAN GULF AND KOREAN THEATERS

CASE I (Iraqi conflict occurs first):

	<u>THEATER</u>	<u>SHIPS</u>	<u>AIRCRAFT SQUADRON</u>
Arrival Day	Iraq	Day 20, 2 MCM-1s	Day 10
		Day 34, 1 MCM-1	
Arrival Day	Korea	Day 50, 3 MCM-1s	Day 10

CASE II (Korean conflict occurs first):

	<u>THEATER</u>	<u>SHIPS</u>	<u>AIRCRAFT SQUADRON</u>
Arrival Day	Korea	Day 1, 2 MCM-1s	Day 10
		Day 50, 1 MCM-1	
Arrival Day	Iraq	Day 34, 3 MCM-1s	Day 10

SOURCE NOTE: Day to arrive in theater with number of MCM ships/aircraft obtained from data in Appendices A and B.

APPENDIX D

NUMBER OF DAYS FOR MCM FORCES TO REACH THE PERSIAN GULF AND KOREAN THEATERS IF TWO MCM-1 SHIPS ARE BASED IN THE PERSIAN GULF

CASE I (Iraq conflict occurs first):

<u>ARRIVAL DAY</u>	<u>THEATER</u>	<u>SHIPS</u>	<u>AIRCRAFT SQUADRON</u>
Arrival Day	Iraq	Day 1, 2 MCM-1s	Day 10
		Day 20, 1 MCM-1	
Arrival Day	Korea	Day 1, 1 MCM-1	Day 10
		Day 50, 2 MCM-1s	

CASE II (Korea conflict occurs first):

<u>ARRIVAL DAY</u>	<u>THEATER</u>	<u>SHIPS</u>	<u>AIRCRAFT SQUADRON</u>
Arrival Day	Korea	Day 1, 2 MCM-1s	Day 10
		Day 20, 1 MCM-1	
Arrival Day	Iraq	Day 1, 1 MCM-1	Day 10
		Day 34, 2 MCM-1s	

SOURCE NOTE: Day to arrive in theater with number of MCM ships/aircraft obtained from data in Appendices A and B.

ENDNOTES

1. Hartmann, Gregory, Weapons That Wait, US Naval Institute, Annoapolis, Maryland, 1991, p ix. Rear Admiral Horne III was the third Commander of the nascent Mine Warfare Command from 1980 to 1985 and wrote that mine warfare "boils down to 85 percent preparation (in peacetime) and 15 percent execution (in wartime)".
2. Lyons, Dwight H. and Baker Eleanor A., "The Mine Threat: Show Stoppers or Speed Bumps?", July 1993, p 15.
3. Aspen, Les, Secretary of Defense, Report on the Bottom-Up Review, Department of Defense, Oct 1993, p 14.
4. Ibid, p 14.
5. Ibid, p 17.
6. Cagle and Manson, The Sea War, p 142.
7. Hartmann, Gregory, Weapons That Wait, US Naval Institute, 1991, p 98.
8. Lyons, Dwight H. and Baker Eleanor A., "The Mine Threat: Show Stoppers or Speed Bumps?", July 1993, p 3.
9. Melia, Tamara Moser. "Damn the Torpedoes" A Short History of US Naval Mine Countermeasures 1777-1991. Washington D.C., Naval History Center, 1991, pp 121,127,128. From the beginning of the Iran-Iraq war in 1980 merchant vessels suffered regular air, surface, and mine attacks by both sides in the transit lanes in the Persian Gulf. Escalation of attacks on commercial vessels in 1984 led Kuwait to request convoy protection from other nations for its tankers. The first convoy of reflagged tankers protected by U.S. Navy warships under the codename Operation Earnest Will began steaming toward Kuwait on 24 July 1987. As escort ships steamed in front and astern, SS Bridgeton hit an M-08 mine off Farsi Island, damaging but not stopping her; On 14 April 1988, while on a routine transit between Earnest Will missions, the frigate Samuel B. Roberts (FFG-58) hit a submerged M-08 mine that blew a 20-foot hole in her hull.
10. Lyons, Dwight H., "The Mine Threat", July 1993, p 4-5.
11. Ibid, p 5.
12. Ibid, p 5.
13. Melia, Tamara, "Damn the Torpedoes" A Short History of US Naval Mine Countermeasures 1777-1991. Washington D.C., Naval History Center, 1991, p 72.

14. Edwards, "A Naval Lesson of the Korean Conflict", p 1339; Anthony Preston, "The Infernal Machine: mines and mine countermeasures" Defense 19 (August 1988), p 561.
15. Melia, Tamara, "Damn the Torpedoes", Naval History Center, 1991, p 73.
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